Fries Mfg. & Power Company - Idols Station, 1897
1/4 mile west of State Route 3000 on Yadkin River
Forsyth County
North Carolina

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Heritage Conservation and Recreation Serivce
Department of the Interior
Washington, D. C. 20243

HISTORIC AMERICAN ENGINEERING RECORD

Fries Manufacturing & Power Company - Idols Station

NC-9

Location:	Near Clemmons, Forsyth County, North Carolina. 1/4 mile west of SR 3000 on Yadkin River. UTM: 17.554220.3981080 Quad: Advance
Date of Construction:	1897-1898; new equipment installed 1914
Original Owner:	Fries Manufacturing & Power Company
Present Owner:	Duke Power Company
Significance:	First hydroelectric plant in North Carolina
Current Condition:	Operating
Historian:	Patrick W. O'Bannon, 1977.

The Fries Manufacturing & Power Company station at Idols is an example of small scale, low head, hydroelectric technology at the end of the 19th century. Many communities throughout the nation were developing the hydroelectric power of their streams and rivers during this period. The Idols plant, completed in 1898, was the first such development in North Carolina. Located on the Yadkin River at a former ferry crossing known as Idols, southwest of Salem, the plant generated approximately 1,000 horsepower and transmitted power 13-1/4 miles to a number of industrial concerns in Salem. [1] The many stations built during this period confronted the problems of power generation and transmission with a variety of engineering solutions. The station at Idols represented but one example of how these obstacles were overcome.

Since 1846, when Francis L. and Henry William Fries formed the F & H Fries Woolen Mills, the Fries family had been pioneers in the industrial development of the Salem region. The three sons of Francis L. Fries (John William, Francis Henry, and Henry Elias) diversified and expanded the family's holdings. John William served as a director of several Fries-controlled companies. Francis Henry organized the Wachovia Loan & Trust Company, served as director for the Fries-owned Arista and South Side textile mills, and superintended work at the F & H Fries Mills. Henry Elias organized the South Side Manufacturing Company, managed the family-owned Wachovia Grain Mills, and served as a vice-president of the Arista Mills. [2]

While at Arista, Henry Elias Fries became interested in the possibility of using electricity to power the mill's machinery. In the 1880s the plant built a generating facility and began converting to electricity for both power and lighting. Convinced that electricity represented a cleaner, less expensive, and more profitable way to operate the mill, Fries determined to expand the generating facility. He became the guiding force, and ultimately, superintendent and manager of the Fries Manufacturing & Power Company. Chartered on 28 February 1891, the company proposed to develop and utilize the water power at Douthit's Shoals on the Yadkin River. [3]

The company existed only on paper until 1896, when plans were made to harness the river's power. These originated when Henry Elias Fries, enroute by train to New York for a dinner honoring President Grover Cleveland, engaged an electrical engineer in a discussion of the feasibility of long distance power transmission. Excited by other hydroelectric projects, notably those at Niagra Falls, and at American Falls, California, Fries consulted an old friend, Robert B. Haines Jr., in Philadelphia. Convinced of the practicality of the scheme he wired Salem to inquire about the possibility of using a 24 acre portion of the Douthit Mill property, owned by his uncle, Henry W. Fries, for the

development of a hydroelectric plant. [4]

A telegram approving the idea quickly reached H. E. Fries, and detailed discussions were held with C. R. Makepeace & Company, Engineers, and Lewis & Claflin, Electrical Engineers, both of Providence, Rhode Island. Makepeace, a native North Carolinian familiar with the area, began preparation of the mechanical and building plans while Lewis & Claflin designed the electrical installation. [5]

In February 1897 the first surveys commenced, and rights-of-way for overhead wires were obtained from the Forsyth County Commissioners. [6] By April, investors had subscribed for $50,000 worth of the $60,000 of capital stock issued by Fries Manufacturing & Power. The firms supplying machinery to the plant invested in the project, as did electrical inventors Thomas A. Edison and Frank J. Sprague. [7]

Throughout the first months of 1897 the company negotiated with property owners whose lands would be flooded by the erection of a dam "at or near Douthit's Falls." According to the agreements, the dam would not raise the level of the river more than six feet, measured on the piers and abutments of the Southern Railway's viaduct directly upstream from the site. [8]

Douthit's Shoals, once the site of a grist mill and its accompanying five-foot tall dam, had been selected for a number of reasons. A large rock outcropping thrust into the river below the existing dam and presented an excellent foundation for the newer, ten-foot tall structure. [9] The eight-foot fall of the river represented another incentive. The low-lying country along the river would have been considerably damaged by a high dam, and the natural fall of the river could be used to supplement the power obtained from a low dam. [10]

Construction commenced in June 1897 with Watkins & Hardaway, of Birmingham, Alabama, having the contract for the masonry work on the dam and powerhouse. [11] They had recently completed work on a similar plant at Anderson, South Carolina. [12] J. C. Batchelor, of Winston-Salem, received the contract for the construction of a 600-foot long siding connecting the construction site to the Southern Railway. This allowed heavy equipment and machinery to be brought directly to the site, eliminating the expenses of hauling by wagon from Winston-Salem. The Winston-Salem Union Republican reported that "the enterprise is in safe hands and will be completed." [13]

Throughout the summer the weather remained good, the river low, and the work progressed rapidly. Many of the men lived in a construction camp erected at the site in order to avoid the 28 mile round trip to Winston-Salem. [14] Lieutenant-Governor Charles A. Reynolds served as chief engineer, devoting all of his time to the project. [15]

The 482-foot, rubble-masonry, curved gravity dam, built upon stone foundations, stood ten feet tall, stepped to 13 feet at both ends. A four-foot wide, stone, baffled, inclined sluiceway fishladder was incorporated into the downstream face of the structure. The crest of the dam measured six feet in width, while the base measured 12 feet. (16) When filled the reservoir had a surface area of approximately 35 acres, with six miles of shoreline. (17)

All the granite stone for the dam and the foundation of the powerhouse was quarried at the site, the majority of the material coming from the south bank of the river opposite the powerhouse. "Blasting and drilling are all that is needed to make the granite ready for use." (18) Presumably the large blocks were barged across the river and placed with steam derricks, although a large share of the work seems to have been done by manual labor. (19)

The powerhouse consisted of a wheel room and a generator room, built at right angles to each other on the northern shore of the Yadkin. The wheel room formed one end of the dam, into which it was built. The dam ran diagonally from the outer upstream corner of the wheel room across to the south shore of the river, where it butted against the railroad abutment. Divided into eight wheel pits, the wheel room measured 145 by 36 feet. The downstream faces of the pits, like the dam, were constructed of rough stone. (20) The foundations extended "down four feet into the rock so that as far as human foresight goes, no freshet, no force can move it." (21)

The division walls of the wheel pits were 18 inches thick, composed of brick, and served as the foundation for the heavy timber construction wheel room. The walls also supported the 10 by 15 inch beams upon which the machinery of the wheel room rested. The exterior face of the building consisted of two-inch wide planking, and a standing-seam tin roof covered the entire structure. (22)

At the entrance of the wheel pits an iron trash rack kept floating debris out of the turbines. Comprised of 3 by 1/4-inch plates, with their centers placed 1-1/2 inches apart. The rack extended 144 feet across the rear of the wheel pits. (23)

A single story brick structure located at the north end of the wheel room comprised the plant's generator room. Constructed with a heavy timber frame, the building measures 39 by 60 feet. The roof, supported by the wooden posts, rose 18 feet above the floor. (24)

Plans called for each wheel pit to be equipped with two turbines, seperated by a 2x12 foot waste gate. All of the units on one side of the waste gates were to be connected to a vertical line shaft by

means of gears connected to the vertical turbine shafts. Each line shaft would supply the motive power to an AC generator. Initially only a single set of turbines and their accompanying generator were installed. The turbines were mounted on a 6-inch pine flooring supported on steel structural members 8 feet below head water. This framework consisted of 12 inch 50-pound-per-foot I-beams running parallel to the river, with 15 inch 75-pound-per-foot I-beams running perpendicularly to these. (25)

A large work force completed the stone work of the powerhouse in mid-October 1897, enabling the turbines to be placed in the wheel pits. (26) The S. Morgan Smith Company, of York, Pennsylvania, supplied the turbines. (27) Custom built by the Smith Company, these were of the McCormich vertical gear type, delivering 165hp each when running under a 9 foot head. (28) Each unit measured 54 inches in diameter. (29) The vertical shafts of the eight turbines carried a large bevel gear with hardwood teeth, which meshed with an iron bevel pinion keyed to the 150-foot long, 7-1/2-inch diameter, horizontal, dynamo shaft. This shaft, mounted in bearings supported by the division walls, attached to the generator by means of flexible, insulated couplings. (30)

The shaft consisted of two sections, each driven by four wheels. By means of a coupling, four or eight wheels could be used. Two Lombard type B water governors, "neat and powerful looking machines," (31) controlled each set of turbines. These hydraulic governors opened or closed the turbine gates. The governors controlled three of the wheels in each set; the fourth was operated by hand. (32)

Throughout the entire plant the S. K. C. system of electrical machinery (manufactured by the Stanley Electric Manufacturing Company of Pittsfield, Massachusetts) was used. The generator, a three-phase induction type with an output of 750 kw at 166 rpm, attracted some attention at the time of its installation by being wound for 12,000 volts, and by delivering three-phase current, at this pressure, to the transmission line without the use of step-up transformers. Fries Manufacturing & Power, and Stanley Electric, claimed it to be 93.5% efficient, with an exciting current only slightly over 0.5% of its output, or about 86 amperes at 45 volts. If functioning properly, no part of the of the generator heated up more than 28^{0} above room temperature. (33)

The generator stood ten feet one-inch tall, weighed 30 tons, and was reportedly the "heaviest single piece of machinery ever transported by our railroads at this place." (34) The two halves could be divided vertically at the shaft, allowing access to the armatures for simple repairs. The generator pit extended 25 to 30 feet below the floor of the generator house to bedrock. It had been grouted and plastered to keep out any high water. (35)

A 14 kw four-pole Crocker-Wheeler machine driven at 1,100 rpm by the turbine shaft, served as the exciter. It delivered current to 70 volts, and was large enough to excite the fields of two generators of the type installed. This eliminated the need for a second exciter should the additional turbines and their generator be installed at a later date. (36)

The switchboard, located in the generator room, consisted of four white marble slab forming a 21-inch square pillar 9-1/2 feet tall. The mountings were lacquered brass-trimmed in oiled hardwood. All live contacts were hidden within the pillar for safety. Three high-tension, single-pole, single-throw switches were mounted on the board. They were plug types with long handles and bayonet locks. Two 12,000-volt static ground detectors were also mounted on the board.

The generator voltage was read from a static voltmeter and switch for the exciter circuit, and the exciter shunt rheostat. As in many power plants of the time, the field rheostat economized space and received better ventilation by being suspended 18 inches below the floor. Its handle ran through the floor near the switchboard. (37)

A lighting protection rack hung above the switchboard. It consisted of three vertical sections, each carrying a set of arrestors and choke coils for each leg of the high-tension circuit. Like all the protection sets along the line, it had choke coils in series with each leg of the circuit, with S. K. C. Arrestors connected so that there were always four between the line and ground. (38) The arrestors were supplied by Stanley, General Electric, and Westinghouse. (39)

All wiring within the station ran beneath the flooring. The high-tension wires were insulated for 25,000 volts, and supported by triple-petticoated porcelain insulators on horizontal cross bars. They reached the switchboard through the bottom of the pillar. The three power lines exited through the top of the pillar, and connected with the transmission wires running into Salem. (40)

In October 1897 crews began erecting the poles for the 13-1/4-mile-long transmission line. (41) They were of white cedar, 36 to 48 feet tall, and sunk 5-1/2 to 6 feet into the ground. The poles were 100 feet apart, except where the line crossed highways, where they were only 50 feet apart. Each pole carried three cross bars. The lower two carried the power circuit. The circuit consisted of three No. 1 soft-drawn, bare copper wires strung on No. 1 Imperial Porcelain insulators, six-inches tall and triple-petticoated. (42) The wires, spaced 24 inches apart, formed an equilateral triangle with the lower cross bar carrying two of the wires. All of the wires were on one side of the pole, leaving the other side open for a future circuit. To overcome problems caused by induction between the wires the triangle was twice rotated, making a total of 240°, between the powerhouse and the distributing station. (43)

The top arm had six pins, of which the outer pair carried an iron, barbed wire ground through a 1/2-inch galvanized iron pipe driven ten feet into the ground at the base of the pole. The inner pins carried a telephone circuit, which could be grounded in case of a storm. Every mile a branch of the telephone circuit was brought down a pole to within a few feet of the ground, allowing people to plug into the line communicate with either end of the circuit. The extra pins on the cross bar were used to transpose the telephone circuit every 500 feet. (44)

The line followed the railroad tracks to a point near Davis School, where it ran straight into the distributing station. The newspapers embarked on a public relations campaign in behalf of Fries Manufacturing & Power in an effort to convince the public that the wires presented no safety hazard. Articles claimed that because of the barbed wire ground circuit, the safest place to be in a thunderstorm was under the power lines. The poles were even falsely described as being so tall that should a wire break it could not reach the ground. (45)

Despite these efforts, there remained a great deal of apprehension about the safety of the power lines. In November, the railroad discovered that the poles had been placed closer to the tracks than the agreed upon 25 feet and demanded that they be moved. Ten weeks and over $1,000 would have to be spent in moving the poles over the eight to ten miles in question. By December 1897 Henry Elias Fries had convinced the railroad to allow the poles to remain where they were. [46]

Installation of the machinery continued through the first months of 1898, and on 11 April the engineers ran a test of the mechanical equipment. It worked "like a charm." The transmission equipment was quietly tested on 13 and 14 April, and, at noon on 18 April 1898, seven-year-old Marguerite Fries threw the switch inaugurating the plant's service. The Union Republican reported that "there was no special demonstration or blowing of trumpets, but our towns, nor State have ever been privileged to witness a greater or more successful achievement." [47]

The line entered the two-story brick sub-station on the second floor. This triangular-shaped building, located near the Arista Mills, at the intersection of Marshall, Wachovia, and Shallowford Streets, distributed the power to various customers. The line had lightning protection from where it entered the building to the main bus bars on the first floor. The ground wires for the lightning protectors throughout the system were No. 1 copper soldered to large copper plates imbedded six to ten feet below ground in powdered charcoal. The plates were either in naturally wet places, or were kept wet by periodically pouring water down connecting pipes. [48]

From the bus bars, metal bars from which the various circuits were taken, the three-pole, high tension circuits passed through nine single-pole, high tension plug switches. The first of these circuits connected to another set of bus bars, in turn connected to the power transformers, finally running to the collection board. The transformers were vertical, self-ventilating types, connected in parallel. Large iron pipes extended through the roof to a ventilation hood standing three feet above the roof. These pipes allowed the heat from the transformers to escape through the hood, keeping the units cool.

The second circuit passed through a lightning protection rack and connected to what was known as the "fertilizer line." This line, 3-1/2 miles long, consisted of three No. 6 insulated wires, and terminated at the Southern Chemical Company, a fertilizer works. Three 25 kw oil transformers reduced the pressure to 600 volts, which drove two induction motors, one of 50 horsepower and one of 30 horsepower.

The third high-tension circuit, like the second, passed through

lightning protection, and connected to the "South Side line." Built like the "fertilizer line," this 2-1/2 mile line supplied power to three 75 kw power transformers at the South Side Cotton Mill, which stepped the pressure down to 600 volts and supplied a 300 horsepower synchronous motor, a 10 horsepower induction motor, and three 80-light transformers. Both of these subsidiary lines were constructed like the main line, except there were no telephone circuits, and the poles were higher in order to clear the city wires. [49]

The sub-station's primary board, placed parallel to and eight feet in front of the west wall, consisted of nine long-handled, high-tension switches with marble bases, mounted in a wooden framework. A Thomson ammeter, mounted on a marble slab, was placed in the middle leg of the circuits.

The collecting board, also wooden framed, mounted six double-throw, single-pole switches. These connected the secondaries of the transformers through 12 single-pole porcelain fuse blocks to the 1,200 volt bus bars, which extended to the distributing board.

This board, like the others mounted in a wood frame, held six 350 ampere, single-pole, single-throw switches on marble bases, two Thomson ammeters, two static ground detectors, and a Bristol recording voltmeter. Two 1,200 volt circuits were taken from this board (having originated in the first high-tension circuit which passed through the transformers). One supplied current to a 300 horsepower synchronous motor in the Winston-Salem Railway & Electric Company plant, and to two induction motors, one of 50 horsepower in the Fogle Brothers shop, and one of 30 horsepower belonging to J. A. Vance. The second circuit powered a 300 horsepower synchronous motor and two 80 horsepower motors of the same type at the Arista Mills. [50]

Originally, many of the mill operators were skeptical of three small wires being capable of transmitting enough power to operate several large mills, but, with the successful implementation of service there was a great clamor to subscribe to the new system and the plant soon reached its output capacity. Power was sold by the meter at a minimum charge of 25 horsepower per year. For a 12 hour day the rates were $20 per horsepower per year, while for a 24 hour day the rates jumped to $40 per horsepower per year. [51]

Shortly after the plant opened the Yadkin flooded, causing Fries Manufacturing & Power to spend $30,000 to lengthen the dam and increase the protection of the powerhouse. These additions raised the cost of the plant to $155,000. [52] Floods did not deter sightseers, who crowded the roads to the site for months to catch a glimpse of the new

facility. [53]

The men at the plant worked 12 hour shifts, with about six men on each shift. The 13-man crew's primary responsibility was to clean debris out of the trash racks with long-handled rakes. At times men manned the rakes for 36 hours straight. [54]

With the plant operating at full capacity shortly after its opening, plans were quickly made to incorporate the additional eight turbines, and their generator, into the system. The Sanborn Insurance Company map for April 1907 shows 16 turbines and two generators in place. The precise date for this installation is unknown, but it seems to have occured around 1903. [55]

On 25 June 1913 Fries Manufacturing & Power was absorbed by the Southern Public Utilities Company, a forerunner of Duke Power. The plant continued to provide power to the industrial mills of Salem. [56]

Duke Power took over the operation in February 1914 and quickly replaced the original machinery with six Allis Chalmers vertical, 54-inch, Francis-type turbines. Each of these machines generated 300 horsepower. Mounted directly above each turbine was an Allis Chalmers 2,300 volt, 74 ampere, 90 rpm, three-phase generator. Each generator had its own switchboard, with instruments manufactured by Westinghouse. The field rheostats were made by Cutler-Hammer of Milwaukee. The main switchboard, located in the wheel room, had instruments built by General Electric. The new exciter, also mounted in the wheelroom, had been built by the Ridgway Dynamo & Engine Company of Ridgway, Pennsylvania. It consisted of a dynamo, manufactured by the Martin Electric Company of Detroit, and rated at 150 kw, 1200 amps, at 1,200 rpm, and a synchronous motor built by Ridgway and rated at 225 horsepower, and 2,300 volts at 1,200 rpm.

The new installation left two of the original wheel pits empty, and resulted in the generator room being converted to a transformer room with four AC shell-type transformers stepping up the power for transmission to the city. These transformers were oil-insulated and water-cooled. [57]

This machinery, with some minor improvements and modifications, remains in use today, 63 years after its installation. The buildings look almost exactly as they did when built 79 years ago. They have withstood several major floods, including a 27-foot rise in the river in July 1916 which placed 5-1/2 feet of water on the floor of the wheel room. An unconfirmed report claimed that this flood knocked out one wall of the transformer house, but it is believed that this report greatly exaggerated the damage. [58]

In 1898 the Fries Manufacturing & Power Company's transmission of 10,000 volts over a distance of 13 miles represented a major, though by no means unprecedented, undertaking in electrical engineering. For this reason the electrical installation at the Idols station received some national attention in technical journals. The station was in many ways representative of the lowhead hydroelectric plants developed throughout the nation in the last decade of the 19th century. The local character of these projects, with their varying geological, climatic, and socio-political conditions, resulted in distinctive solutions to the problems involved in the commercial distribution of electricity. Though the original equipment was replaced in 1914, the Idols plant still exists as an important facility, providing physical evidence of a first generation, long distance AC power system.

NOTES

[1]Samuel A'Court Ashe, History of North Carolina, (Raleigh: Edwards & Broughton Printing Company, 1925), p. 1219.

[2]R. D. W. Connor, History of North Carolina, 6 vols. (New York: The Lewis Publishing Company, 1919), 5:2.

[3]Twin City Sentinel, 1 December 1975.
The directors of the Fries Manufacturing & Power Company were Henry W., John W., Henry E., and Francis H. Fries, J. W. Hanes, C. H. Fogle, W. A. Whitaker, J. C. Buxton, and C. B. Watson.

[4]Henry Elias Fries, Electrical Development in Winston-Salem, North Carolina, pp. 1-2.
Land Deed, 29 June 1897, Henry W. Fries to The Fries Manufacturing & Power Company, vol. 52, p. 588, Forsyth County Land Deeds, North Carolina State Archives. Volume and page number refer to microfilm index.

[5]Fries, p. 2.
Unidentified newspaper article dated 17 November 1928 found in North Carolina Room of the Forsyth County Library.

[6]The Union Republican, 4 February 1897, p. 2.

[7]The Union Republican, 8 April 1897, p. 3.
Unidentified article dated 17 November 1928.

[8]Various deeds from Forsyth County Record of Deeds, vol. 52, North Carolina State Archives.

[9]Fambrough Brownlee, Winston-Salem: A Pictorial History, (Norfolk, Virginia: Donning Company Publishers, 1977), p. 119.
Twin City Sentinel, 6 October 1897, p. 1.

[10]"The Transmission Plant of the Fries Manufacturing & Power Company," American Electrician 10 (October 1898): p. 447.

[11]Twin City Sentinel, 25 May 1897, p. 3.

[12]"Power Plant on the Yadkin River," Fire and Water (27 November 1897): p. 427.

[13]The Union Republican, 3 June 1897, p. 3.

[14]The Union Republican, 14 October 1897, p. 3.
Twin City Sentinel, 1 December 1975.

[15]Twin City Sentinel, 27 September 1961.

[16]American Electrician, p. 447.

[17]Typescript of Hydroelectric Plant Data for the Idols Power plant, compiled 29 March 1932, in possession of E. A. Payseur, Manager of Idols Station.

[18]The Union Republican, 14 October 1897, p. 3.

[19]Interview with Charles Keaton, former employee of Idols station, 28 June 1977.

[20]American Electrician, p. 448.

[21]The Union Republican, 14 April 1898, p. 1.

[22]Blueprints of Fries Manufacturing & Power Company plant prepared by Charles Makepeace, Providence, Rhode Island, dated May 1897. Held by Duke Power Company, Charlotte, North Carolina.

[23]Ibid.

[24]American Electrician, p. 448.

[25]Ibid., p. 448.
Blueprints, May 1897.

[26]The Union Republican, 14 October 1897, p. 3.

[27]Smith, like Makepeace, was a native North Carolinian. His brick and stone shop, 1,100 by 150 feet, was the largest manufacturer of cotton mill machinery in the country.
The Union Republican, 22 April 1897, p. 3.

[28]Twin City Sentinel, 1 December 1975.
American Electrician, p. 448.

[29]Winston Tobacco Fair, Winston, North Carolina, November 2, 3, and 4, 1898, (Winston: Stewart's Printing House, 1898), p. 17. Available in North Carolina Room, Forsyth County Library.

[30]American Electrician, p. 448.
R. L. Womack, "Looking Back Twenty-five Years," Southern Public Utilities Magazine, 2 (February 1915): p. 38.

[31]The Union Republican, 14 April 1898, p. 1.

[32]American Electrician, p. 448.

[33]Twin City Sentinel, 1 December 1975.
American Electrician, p. 448.

[34]The Union Republican, 14 April 1898, p. 1.

[35]American Electrician, p. 448.

[36]Ibid., p. 449.

[37]Ibid.

[38]Ibid., p. 450.

[39]Fries, p. 3.

[40]American Electrician, p. 450.

[41]The Union Republican, 14 October 1897, p. 3.

[42]American Electrician, p. 450.
Fire and Water, p. 427.

[43]American Electrician, p. 450.

[44]Ibid.

[45]The Union Republican, 4 November 1897, p. 3.
The Union Republican, 25 November 1897, p. 3.

[46]The Union Republican, 25 November 1897, p. 3.
The Union Republican, 16 December 1897, p. 31

[47]The Union Republican, 14 April 1898, p. 6.
The Union Republican, 21 April 1898, p. 2.

[48]Sanborn Insurance Company Maps, 1917, sheet 94. Available at University of North Carolina at Chapel Hill, North Carolina Room.
American Electrician, p. 450.

[49]American Electrician, p. 450.

[50]Ibid.

[51]Womack, p. 36.
George Swain, J. A. Holmes, and E. W. Meyers, Papers on the Waterpower in North Carolina, Bulletin 8, (Raleigh: North Carolina Geological Survey, 1899), p. 350.

[52]Twin City Sentinel, 1 December 1975.
Swain, p. 350.

[53]Twin City Sentinel, 27 September 1961.

[54]Keaton interview.

[55]American Electrician, p. 450.
Sanborn Insurance Company Maps, Winston-Salem, April 1907, sheet 35.

[56]Fries, p. 4.

[57]Hydroelectric Plant Data.

[58]Unidentified newspaper article dated 4 May 1935, found in Old Salem Scrapbook, p. 56, in North Carolina Room, Forsyth County Library.

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Ashe, Samuel A'Court. History of North Carolina. Raleigh: Edwards & Broughton Printing Company, 1925.

A general history of the state, with a brief mention of the Fries plant, and a list of the first customers.

Brownlee, Fambrough. Winston-Salem: A Pictorial History. Norfolk, Virginia: Donning Company, Publishers, 1977.

As the title suggests, a pictorial history of the town, but with a brief paragraph on the Fries project, and the only photograph located of the plant while under construction.

Connor, R. D. W.. History of North Carolina. New York: The Lewis Publishing Company, 1919.

Another state history, used for the biographical data on the Fries family.

Forsyth County, North Carolina. Records of Deeds. (1897 - 1913), vols. 52, 55, 124.

The land deeds show the agreements between the Fries interests and those property owners whose land would be damaged by the project. The cost of securing the rights to build the dam can be ascertained from these documents. The later deeds document the sale of the Fries interests to the Southern Public Utilities Company in 1913.

Fries, Henry Elias. "Electrical Development in Winston-Salem, North Carolina." Typescript dated June 1933. Drawer M. Salem Station, Moravian Archives.

A relation, by Henry E. Fries, of his role in the electrification of Winston-Salem. The facts in the report are very accurate. Good on the background behind the project.

Hydroelectric Plant Data. Typescript in the possession of E. A. Payseur, Manager of Idols Power Plant. Compiled March 29, 1932.

A two sheet listing of technical data on the plant as it was in 1932. The only technical information located on the turbines and generators installed in 1914.

Keaton, Charles. Former employee of Fries Manufacturing & Power Company. Interview, 28 June 1977.

Mr. Keaton began working at the station shortly after it opened. He provided valuable information on the early operation of the plant as did Mr. W. D. Kirkpatrick, of Duke Power, who was present during the interview.

Makepeace, Charles R. Blueprints for the Fries Manufacturing & Power Company. May 1897.

The original blueprints for the plant, kindly provided by Duke Power. They provided valuable information on the manner in which the buildings were constructed and the machinery installed.

Old Salem Scrapbook. North Carolina Room. Forsyth County Library.

A scrapbook of old newspaper clippings dealing with the history of Winston-Salem and Forsyth County. Many of these articles are unidentified, and the one consulted offered some rather dubious information on the 1916 flood.

"Power Plant on the Yadkin River," Fire and Water. (27 November 1897): 427-428.

A brief article touching upon the major points of interest in the plant. Contains information available elsewhere, except for three excellent photographs of the powerhouse while under construction.

Sanborn-Perris Map Company. Sanborn Insurance Maps of Winston-Salem. 1900-1917.

A set of insurance maps prepared by a fire insurance company which provide valuable data on the nature of many structure's construction. Their large scale and extreme accuracy makes them a valuable source for determining changes in the physical plant. Available at the North Carolina Room of the University of North Carolina at Chapel Hill library.

Swain, George and J. A. Holmes and E. W. Meyers. Papers on the Water-power in North Carolina. Bulletin 8. Raleigh: North Carolina Geological Survey, (1899).

An excellent outline of the workings of the plant. Good information on the machinery as originally installed, and on the methods by which the power was sold to the customers.

"The Transmission Plant of the Fries Manufacturing & Power Company," American Electrician 10 (October 1898): 447-450.

An outstanding catalog of the electrical equipment used throughout the entire system. Several excellent photographs of the machinery both at the powerhouse and the sub-station in Salem.

Twin City Sentinel, 25 May 1897; 6 October 1897; 27 September 1961; 1 December 1975.

The two early articles provide some information on the construction of the dam, while the later articles outline the major points in the construction and operation of the project.

Unidentified newspaper clipping. North Carolina Room. Forsyth County Library. 17 November 1928.

An article dealing with the project in generalities, but with some information of value.

The Union Republican, 4 February 1897 - 21 April 1898.

Coverage of the project was surprisingly scanty in the contemporary newspapers for an endeavor of such importance, but one gets a feeling of the public's apprehensions by reading the assurances of the power line's safety.

Winston Tobacco Fair, Winston, North Carolina, November 2, 3 and 4, 1898. Winston: Stewart's Printing House, 1898.

A pamphlet published for the fair which contains several boosteristic articles on the achievements of Winston-Salem and Forsyth County, including a page on the Fries plant. A general description of the plant's facilities and capabilities.

Womack, R. L. "Looking Back Twenty-five Years," Southern Public Utilities Magazine 2 (February 1915): 38.

A brief description of the plant in the magazine of the Southern Public Utilities Company.